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High-field (30 tesla) Pulsed-magnet Instruments for X-ray Studies of Materials

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Pulsed magnets have emerged as a viable approach at synchrotron x-ray facilities for studying materials in high magnetic fields. We present two extremely high-field (30 tesla) pulsed magnet systems for x-ray diffraction studies of materials at the Advanced Photon Source (APS). These instruments employ unique two-cryostat schemes. The first is a split pair of mini-coils (duration ~1ms) with applied magnetic field normal to the scattering plane [1]. The second is a single 18-mm bore solenoid (duration ~4 ms) that allows the applied field to be parallel to the scattering plane. Both coils have been designed and built at Tohoku University using high-tensile-strength and high-conductivity CuAg wires. Dual-cryostat schemes have been developed at the APS in order to cool the coil and the sample independently. The split-pair magnet is conduction cooled using a close-cycle cryostat while the solenoid is cooled in liquid nitrogen (LN). While a repetition rate for the split-pair magnet is ~10–20 minutes for peak fields in the range of 20–30 tesla, LN cooling allows a repetition rate of a few minutes for peak fields near 30 tesla in the solenoid. Pulsed fields are generated by a capacitive discharge using a configurable bank (3 kV, 40 kJ). Time-resolved diffraction data are typically collected using a fast avalanche photodiode or a one-dimensional strip detector. Results from preliminary scattering studies of structural effects and magneto-striction in a geometrically frustrated magnet will be presented.

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